NOTES ON ANT-LYCAENID ASSOCIATIONS (HYMENOPTERA: FORMICIDAE AND LEPIDOPTERA: LYCAENIDAE) IN SOUTHEAST QUEENSLAND

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Abstract

Thirty-one new ant associations are reported for immature stages of facultatively myrmecophilous lycaenid butterflies from southeast Queensland. Larvae of three species, *Rapala varuna* (Horsfield), *Erysichton lineata* (Murray) and *Psychonotis caelius* (C. Felder), are reported in weak associations with ants for the first time. The introduced ant *Technomyrmex ?albipes* (Smith) is identified as the most common attending ant of facultative lycaenids in disturbed habitats around Brisbane.

Introduction

An interesting feature of lycaenid biology is the mutualistic associations between their immature stages and ants (Pierce *et al.* 1987). These associations vary in intensity and in the degree of specificity between partners (Fiedler 1991, Eastwood and Fraser 1999). Larvae of many lycaenid species possess specialised glands which attract, reward and appease attendant ants that may otherwise be aggressive towards them (Malicky 1970). In return ants may protect lycaenid larvae against predators and parasitoids (Pierce *et al.* 1987).

A recent review of lycaenid-ant associations in Australia by Eastwood and Fraser (1999) provided a classification for the level of ant attendance typical for mature larvae of each species. Facultatively ant-associated lycaenids are attended by a broad range of (usually) ecologically subordinate ants, while obligately ant-associated species are attended by a restricted range of (usually) ecologically dominant ants.

This paper reports on a collection of ants found attending lycaenid immature stages in southeast Queensland. Results are discussed in light of Eastwood and Fraser's (1999) review.

A voucher collection of ants is lodged in the Queensland Museum. Butterfly nomenclature follows Braby (2000), spelling of lycaenid names follows Common and Waterhouse (1981). Ant nomenclature follows Shattuck (1999) and R. Kohout (pers. comm.) for *Polyrhachis* spp.

Results

Details of all lycaenid-ant associations recorded in this survey are presented in Table 1. New records involving lycaenids with no previously recorded ant associations and new records of poorly documented associations are discussed below. Other new records and confirmation of previously recorded associations appear in Table 1 only.

Table 1. Ant attendance records for lycaenid butterfly larvae and pupae in southeast Queensland. DM= Degree of Myrmecophily (from Eastwood and Fraser 1999): 0, no interaction; 1, weakly myrmecophilous; 2, moderately myrmecophilous; 3, steadily myrmecophilous; 4, obligately myrmecophilous. Numbers in parentheses indicate modified degree of myrmecophily from present study. AL= Attendance Level (after Eastwood and Fraser 1999): N, not attended; L, light attendance <5 ants; H, heavy attendance >5 ants. Ant subfamilies are indicated at first mention of taxon.

Lycaenid taxon	DM	AL	Attending ant *: new record L: ants attending larva P: ants attending pupa	Location (Date)
Hypochrysops cyane (Waterhouse & Lyell)	4	H	*Anonychomyrma* sp.^{LP} (Dolichoderinae)	Inala (15.viii.1999)
		H	*Anonychomyrma* sp.^{LP}	Indooroopilly (i.2000)
H. epicurus Miskin	4	H	*Anonychomyrma* sp.^{LP}	Redland Bay (5.ii.2000)
H. ignitus ignitus (Leach)	4	H	*Papyrius* sp.^{LP} (Dolichoderinae)	Peregian Beach (12.xii.1999)
H. digglesii (Hewitson)	4	H	*Crematogaster* sp.^{LP} (Myrmicinae)	nr Mt Elliot, Boonah (2.vi.1999)
H. apelles (Fabricius)	4	H	*Crematogaster* sp.^{LP}	Redland Bay (5.ii.2000)
H. byzos (Boisduval)	1	N	Not Attended	Girraween (31.i.2001)
Philiris innotata (Miskin)	1	L	*Technomyrmex ?albipes* *^{L} (Dolichoderinae)	Landsborough (11.ii.2001)
		N	Not attended	Oxley Ck, Moggill Ck, Landsborough
Ogyris genoveva (Hewitson)	4	H	*Camponotus* sp.^{L} (Formicinae)	Leslie Dam, Warwick (18.iii.2000)
		H	*Camponotus* sp.^{L}	Leyburn (31.i.2001)
O. zosine (Hewitson)	4	H	*Camponotus* sp.^{LP}	nr Mt Elliot, Boonah (2.vi.1999)
		H	*Camponotus* sp.^{L}	nr Mt Elliot, Boonah (27.vi.1999)
		H	*Camponotus* sp.^{LP}	nr Mt Elliot, Boonah (21.v.2000)
O. abrota (Westwood)	3	L	*Crematogaster* sp.^{LP}	Crows Nest (i.2000)
		N	Not Attended	Girraween (31.i.2001)
O. amaryllis amaryllis (Hewitson)	4 (3)	L	*Crematogaster* sp.^{LP}	Wacol (30.i.1999)
		L	*Crematogaster* sp.^{L}	Beenleigh (26.xi.2000)
		L	*Crematogaster* sp.^{L}	Redland Bay (3.xii.2000)
		L	*T. ?albipes* *^{LP}	Redland Bay (17.ix. & 3.xii.2000)

O. amaryllis amaryllis (cont.)		L	*Paratrechina* sp.*[L] (Formicinae)	Pullen Pullen Ck (23.vii.2000)
		N	Not attended	Wacol, Moggill Ck, Oxley Ck, Pullen Pullen Ck
O. oroetes oroetes (Hewitson)	3	L	*Rhytidoponera* sp.*[L] (Ponerinae)	Ebbw Vale (7.ii.1999)
		L	*Ochetellus* sp.[L] (Dolichoderinae)	Gailes (7.ii.1999)
		L	*Ochetellus* sp.[P]	Kookaburra Park, Salisbury (13.ii.1999)
		L	*T. ?albipes* *[L]	Salisbury Park, Salisbury (6.ii.1999)
		L	*Meranoplus* sp.[L] (Myrmicinae)	Leslie Dam, Warwick (18.iii.2000)
		L	*Crematogaster* sp.[P]	Eight Mile Plains (6.ii. & 22.viii.1999)
		L	*Crematogaster* sp.[P]	Corinda
		L	*Iridomyrmex* sp.[P] (Dolichoderinae)	Kookaburra Park, Salisbury (6.ii.1999)
		N	Not attended	All above locations
O. olane (Hewitson)	3	L	*Crematogaster* sp.[P]	Eight Mile Plains (22.viii.1999)
		L	*Crematogaster* sp.[L]	Leslie Dam, Warwick, not collected (18.iii.2000)
		L	*?Iridomyrmex* sp.[P]	Kookaburra Park, Salisbury (22.viii.1999)
		N	Not attended	Browns Plains, Salisbury, Indooroopilly, Gailes, Leyburn
O. barnardi barnardi (Miskin)	3	L	*Crematogaster* sp.[P]	Leyburn (3.x.1999)
		N	Not attended	Leyburn
Jalmenus evagoras evagoras (Donovan)	4	H	*Iridomyrmex* sp.[LP]	Toohey Forest (x.2000)
		H	*Iridomyrmex* sp.[LP]	Toowoomba (5.iv.1999)
		H	*Iridomyrmex* sp.[LP]	Mt Coot-tha
Deudorix diovis Hewitson	1	L,H	*Pheidole megacephala* *[LP] (Myrmicinae)	South Brisbane (20.ix.1999; 19.x. & 25.xi.2000)
		L,H	*T. ?albipes* *[L]	South Brisbane (12. xi.1998; 19.x.1999)
		L	*T. ?albipes* [LP]	Oxley Ck, Corinda (9.i.2000)

Deudorix diovis (cont.)		L	*T. ?albipes* [P]	Wishart (11.viii.1999)
		L	*T. ?albipes* [L]	Graceville (15.x.2000)
		L	*Iridomyrmex* sp.*[L]	South Brisbane (11.xi.1999; 19.vii.2000)
		L	*Iridomyrmex* sp.[L]	Corinda (29.x.2000)
		L	*Iridomyrmex* sp.[P]	Oxley (27.viii.2000)
		L	*Iridomyrmex* sp.[L]	Wishart (15.x.2000)
		L	*Tetramorium* sp.*[LP] (Myrmicinae)	Sherwood (14.xi.1999)
		L	*Polyrhachis* (*Chariomyrma*) *aurea* Mayr *[L] (Formicinae)	Archerfield (19.xi.2000)
		L	*Polyrhachis* (*Cyrtomyrma*) *australis* Mayr *[L]	South Brisbane (i.2000)
		L	*Polyrhachis* sp.[L]	Sherwood, specimen lost (15.v.2000)
		L	*Polyrhachis* (*Hagiomyrma*) *lydiae* Forel *[L]	Archerfield (19.xi.2000)
		L	*Paratrechina* sp.*[P]	Archerfield (v.2000)
		N	Not attended	All above locations
Rapala varuna (Horsfield)	0 (1)	L	*T. ?albipes* *[L]	Oxley Ck, Corinda (xii.1999)
		L	*T. ?albipes* [L]	Sherwood (25.iv.2001)
		N	Not attended	Oxley Ck, Toohey Forest, Sherwood,
Candalides margarita (Semper)	1	N	Not attended	Moggill Ck, Sherwood, Rocklea
C. absimilis (C. Felder)	1	L	*Polyrhachis* (*Cyrtomyrma*) *australis* *[L]	Sherwood (19.i.2000)
		L	*T. ?albipes* *[L]	Herston (1.iv.2000)
		L	*Iridomyrmex* sp.*[L]	Sherwood (29.x.2000)
		N	Not attended	Springwood, Sherwood
Nacaduba berenice (Herrich-Schäffer)	2	L	*Paratrechina* sp.[L]	South Brisbane (1.ix.1999)
		L	*Pheidole megacephala* *[L]	Brisbane CBD (17.iii.2000)
		L	*Crematogaster* sp.[L]	Mt Coot-tha (18.ii.2001)
		H	*T. ?albipes* *[L]	Sherwood (9.iv.2000)
		L,H	*T. ?albipes* *[L]	Brisbane CBD (14.ii.2001)
		L	*Polyrhachis* (*Cyrtomyrma*) *australis* *[L]	South Brisbane (iii.2000; 12.ii.2001)

Nacaduba berenice (cont.)		L	*Polyrhachis* sp.[L]	Coopers Plains (viii.2000)
		L	*Tapinoma* sp.*[L] (Dolichoderinae)	South Brisbane (12.ii.2001)
		N	Not attended	Sherwood, South Brisbane
N. biocellata (C. Felder & R. Felder)	2	L	*T. ?albipes* *[L]	Oxley Ck, Corinda (28.ix.2000)
		N	Not attended	Sherwood, Rocklea, Toohey Forest, Mt Coot-tha
Erysichton lineata (Murray)	0 (1)	L	*Polyrhachis* (*Cyrtomyrma*) *pilosa* Donisthorpe *[L]	Sherwood (21.iv.2000)
		N	Not attended	Sherwood, Wishart, Mt Coot-tha, Mt Glorious
Psychonotis caelius (C. Felder)	0 (1)	L	*T. ?albipes* *[L]	Oxley Ck, Corinda (xii.1999)
		N	Not attended	Oxley Ck, Toohey Forest, Springwood
Prosotas felderi (Murray)	0 (1)	L	*Crematogaster* sp.[L]	Rocklea (14.v.2000)
		L	*Dolichoderus* sp.*[L] (Dolichoderinae)	nr Mt Elliot, Boonah (21.v.2000)
		N	Not attended	Sherwood, Rocklea, Toohey Forest, Springwood, Mt Coot-tha
P. dubiosa (Semper)	0	N	Not attended	Sherwood, Mt Coot-tha
Catopyrops florinda (Butler)	2	L,H	*T. ?albipes* *[L]	Herston (1.iv.2000)
		L	*Polyrhachis* (*Cyrtomyrma*) *australis* *[L]	Benwarra Park, Oxley Ck
		N	Not attended	Rocklea, Sherwood, Brisbane CBD
Sahulana scintillata (T.P. Lucas)	0	N	Not attended	Rocklea, Toohey Forest, Mt Coot-tha
Leptotes plinius (Fabricius)	2	L	*Iridomyrmex* sp.*[L]	Sherwood (26.ii. & 8.x.2000)
		L	*Paratrechina* sp.*[L]	Sherwood (29.xii.2000)
		N	Not attended	Sherwood, Brisbane CBD, Springwood
Lampides boeticus (Linnaeus)	3	N	Not attended	Corinda, South Brisbane
Zizina labradus (Godart)	3	L	*Iridomyrmex* sp.*[L]	South Brisbane (21 & 28.ix.2000)
		L	*Prolasius* sp.*[L] (Formicinae)	South Brisbane (28.ix.2000)
		N	Not attended	South Brisbane

New records

Philiris innotata (Miskin)

Larvae were not attended by ants at several sites in Brisbane and at Landsborough (Table 1). On one tree at Landsborough 6 out of 20 larvae were each attended by a single *Technomyrmex ?albipes* (Dolichoderinae) worker at the time of collection. The ants antennated over the entire larval dorsal surface but concentrated their efforts at the dorsal nectary organ (DNO) on the seventh abdominal segment. Ant attendance of this species has been recorded on only a few occasions from northern Queensland (Eastwood and Fraser 1999). This record is the first from the southern part of its range.

Rapala varuna (Horsfield)

A single *T. ?albipes* worker was found attending a larva feeding on *Alphitonia excelsa* at Oxley Ck, Brisbane. This ant rapidly antennated the DNO, but paid no attention to other regions of the larva. Other larvae were ignored by *T. ?albipes* and by several other ants (*viz. Polyrhachis* sp., *Iridomyrmex* sp.), which were foraging for nectar on the flowers within centimeters of many *R. varuna* larvae. A single mature larva found feeding on flowers of *Eriobotrya japonica* at Sherwood, Brisbane, was continuously attended by five *T. ?albipes* ants. The ants removed droplets of clear fluid from the larval DNO and on several occasions the larval tentacular organs (TO's) were fully everted. Ant attendance has not been reported previously for *R. varuna* larvae (Eastwood and Fraser 1999).

Erysichton lineata (Murray)

A single ant, *Polyrhachis* (*Cyrtomyrma*) *pilosa* Donisthorpe (Formicinae), was found straddled over a mature larva located on a flower of *Macadamia integrifolia* at Sherwood, Brisbane. The ant and larva remained in contact after several days in captivity, during which time the ant was observed to antennate and remove fluid from the DNO on numerous occasions. The larva also everted its TOs in the presence of the ant. Ant attendance of *E. lineata* has not been reported previously (Eastwood and Fraser 1999) and is a rare occurrence in Brisbane, where numerous unattended larvae were observed (Table 1).

Psychonotis caelius (C. Felder)

Two larvae feeding on flowers of *Alphitonia excelsa* at Oxley Ck, Brisbane were each attended by single *T. ?albipes* workers. The ants alternated between antennating the larval DNO for brief periods (never for more than about five seconds) and foraging on flowers. The larva in each case did not respond in any noticeable way to the ants. Larval TO's were not seen in a fully extended state. Ant attendance has not been reported previously for this species (Eastwood and Fraser 1999) and the great majority of larvae found in Brisbane were unattended.

Prosotas felderi (Murray)

Five larvae on a single food plant, *Acacia disparrima* subsp. *disparrima* at Rocklea, Brisbane were each attended by a single *Crematogaster* sp. (Myrmicinae) worker. All larvae on nearby trees were unattended. Near Mt. Elliot at Boonah, a single larva was found with a large *Dolichoderus* sp. (Dolichoderinae) worker in attendance. In captivity the ant remained with the larva until it pupated several days later. All ant tended larvae responded to attention by the ants with intermittent extension of the TO's and production of fluid droplets from the DNO which the ants removed. Ant attendance of *P. felderi* is uncommon with only one prior report (Braby 2000).

Discussion

Lycaenid-ant associations reported here are in accordance with the patterns described by Eastwood and Fraser (1999). Facultative species such as *Deudorix diovis* Hewitson, *Ogyris oroetes* (Hewitson) and *Nacaduba berenice* (Herrich-Schäffer) are able to appease a variety of ant genera from several subfamilies. The 31 new facultative ant-lycaenid associations reported in Table 1 are therefore unsurprising. Ant genera commonly found in facultative association with lycaenid larvae in this survey include *Technomyrmex* (associated with 10 species), *Crematogaster* (7 species), *Iridomyrmex* (6 species), *Polyrhachis* (5 species) and *Paratrechina* (4 species). These genera commonly associate with facultative myrmecophilous lycaenids (see Eastwood and Fraser 1999).

The high incidence of association with *Technomyrmex* is unusual and possibly reflects the abundance of *T.* ?*albipes* in Brisbane. *Technomyrmex albipes* is native to Japan and is now a nuisance pest in many tropical countries owing to its habit of forming large colonies (estimated to sometimes exceed 1 million individuals) in residential areas (Weissling *et al.* 1998). It is a common ant in disturbed habitats such as suburban parks, gardens and remnant bushland in Brisbane (D. Schmidt pers. obs.). At sites such as Oxley Ck, Corinda the high local abundance of *T.* ?*albipes* appears to be achieved by its large colony size and interconnected colony structure. Nests often occurred under flaking bark of trees and individuals foraged at high densities over virtually all vegetation in the area. In these situations lycaenid larvae and homopterans often are attended and even normally unattended species such as *Psychonotis caelius* receive some attention. The ecological impact of *T. albipes* in Australia is unknown.

Larvae of *R. varuna*, *E. lineata*, *P. caelius* and *P. felderi* possess typical lycaenid myrmecophilous organs including a dorsal nectary organ and tentacular organs. Each of these species was found to be weakly myrmecophilous, their larval stages rarely being found with attendant ants and therefore all would be classified as level 1 in the schema of Eastwood and Fraser (1999).

Larvae of lycaenids classified as obligately ant associated by Eastwood and Fraser (1999) (*e.g. Hypochrysops* spp.), were in most cases found with their characteristic ant genera in attendance (Table 1). One exception was *Ogyris amaryllis amaryllis* (Hewitson), which was found with several different genera and subfamilies of ants in attendance (Table 1). Eastwood and Fraser (1999) recognised this species as an anomaly in their review and additional records here confirm that further work is required to understand the ant associations exhibited by this taxon over its vast range (Schmidt and Rice, in press). Due to the low attendance levels observed during this study and the range of ants found in attendance, the subspecies *O. a. amaryllis* is tentatively treated here as facultatively myrmecophilous in southeast Queensland.

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